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EVALUATION OF TOMATO CULTIVARS FOR PROCESSING

by

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The 1971 processing tomato project included 9 cultivars of tomatoes which were grown in replicated plots under acceptable commercial practices at the Ohio Agricultural Research and Development Center - Northwestern Branch, Hoytville, Ohio. Each cultivar was machine harvested on September 7th, September 13th, and September 23rd (with FMC Western Model) and bulk handled in 400 pound lots, either dry, or in water containing 500 ppm chlorine dioxide. Following harvest, the tomatoes were transported by truck (approximately 100 miles) to the Food Processing Pilot Plant at The Ohio State University, Columbus, Ohio for processing. All lots were processed after 12 hours hold following harvest for peeled tomatoes, and after 24 hours for juice manufacture.

QUALITY EVALUATION

1. U. S. Grade was determined on a 25 pound sample by segregating tomatoes with No. 1's, No. 2's for color, No. 2's for defects, and culls. Any tomatoes that were both No. 2 in defects and No. 2 for color were placed in the No. 2's for defect category.

2. Size was determined by counting the number of fruits in the 25 pound sample. In addition the tomatoes were subjectively classed for shape, core, and firmness.

3. 20 field run tomatoes were selected and used for objective quality evaluation. The sample was cut in half, quartered, extracted in Food Processing Equipment Co. Laboratory pulper, and deaerated.

    a. The sample was evaluated for color with the Hunter Color and Color Difference Meter using the wide area illuminator and large aperture. The instrument was standardized with the "Red" tile with L = 25.59, aL = 27.40, and bL = 12.54.

    b. Juice Color. Agtron F samples of raw or canned tomato juice were presented to the Agtron F instrument in a standard plastic sample cup. The instrument was standardized, using a black plastic plate (Monsanto Lustrex 11250) at 70. Readings were taken directly.

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*Assistance of Professors E. K. Alban, Vegetable Crop; James Trotter and staff, Northwestern Branch OARDC: and The Processing and Technology assistants -- Jacquelyn Gould, Carl Hawkins, John Mount, Jerry Pope, Tim Stover, James Swinehart, and Roberta Topits is gratefully acknowledged.

c. Percent soluble solids. An Abbe 3L refractometer was used for direct determinations of percent soluble solids and refractive indice on raw or canned juice. The instrument was standardized with distilled water and all readings converted to 20°C. No correction is made for salt.

d. Percent total acid as citric. The sample (raw or canned) used for pH determination was directly titrated using 0.1 normal sodium hydroxide solution to a pH of 8.1. Calculations using the following equation were made:

$$\% \text{ acid} = \frac{(\text{No. of ml. of 0.1 N NaOH})\ (.0064)}{\text{10 ml. sample}} \times 100$$

e. pH. The pH was determined by the glass electrode method (Beckman Zeromatic pH meter) using 10 ml. of tomato juice (raw or canned) diluted with 90 ml. of distilled water.

f. Vitamin C. Ten ml. aliquots of tomato juice were diluted with 90 ml. of 1% meta phosphoric acid and filtered. A 10 ml. aliquot of the filtrate was titrated with 0.2% 2, 6-dichlorophenolindophenol indicator solution. Milligrams of vitamin C were determined by the following formula:

$$\text{Dye factor} \times \text{ml. of dye} \times 100 = \frac{\text{mgm. Vit. C}}{\text{100 gms.}}$$

g. Viscosity. The viscosity was measured using the GOSUC efflux tube instrument containing a 5/64" opening and standardized at 32 seconds at 25°C. with water. The rate of flow from the instrument was measured with a stop watch and the readings were recorded directly in seconds.

4. Grades of Canned Tomatoes. The grade was determined in accordance with the U.S. Standards for Grades of Canned Tomatoes.

5. Grades of Canned Tomato Juice. The grade was determined in accordance with the U.S. Standards for Grades of Canned Tomato Juice.

PREPARATION AND PROCESSING

All tomatoes were prepared by washing, lye peeling (18% caustic soda and Faspeel at 200°F. for 20 to 30 seconds), and processed as whole tomatoes or washed, chopped, hot broken at 190°F., extracted and plate pasteurized at 250°F. for 0.7 seconds, filled, closed and cooled in the OSU Pilot Plant. Each lot of whole tomatoes was filled to 10.5 - 11.0 ounces in No. 303 plain tin cans with 30-grain salt (21 grains Sodium and 9 grains Calcium Chloride) added.

Table I - 1971 Raw Product Tomato Cultivar Evaluation - Grade, Size, and Subjective Evaluation

Average for all Harvests

Cultivar	Count/ 25 lb.	Percentage				Firmness	Shape	Core
		US No.1	US No.2C	US No. 2D	Culls			
Chico III	253	69.8	16.2	14.0	-	Medium	Pear - Oval	Small
Ohio 21-70	197	71.5	19	9.5	-	Soft	Round - Oval	Small
Ohio 28-70	146	59.6	21.3	19.1	-	Soft	Round	Large
Ohio 20-70	208	79	10.3	9.8	.7	Medium	Round	Large
Mars	172	65	27.8	5.2	1.9	Soft	Round - Semi Pear	Medium
CS 290	233	77.3	12.3	7.7	2.6	Firm	Round	Small
Ohio 38-70	151	70.0	19.4	9.2	1.4	Medium	Round	Small
Ohio 15-70	175	60.1	27.8	10.3	1.9	Soft	Oval - Pear	Small

Table II - Raw Product Tomato Cultivars Evaluation - Objective Quality and Chemical Analysis

Average for all Harvests

Cultivar	Hunterlab			Agtron F	% SS	% Citric	pH	Vit. C
	L	a	b					
Chico III	27.7	29.6	11.9	36.7	5.3	.35	4.6	13.5
Ohio 21-70	30.8	30.9	12.6	50.2	4.9	.42	4.4	14.1
Ohio 28-70	29.5	31.4	13.1	42	5.6	.43	4.5	17.3
Ohio 20-70	29.3	31.3	13.4	43	6.5	.43	4.5	17.8
Mars	28.1	30.9	12.1	37.8	5.3	.38	4.4	15.2
CS 290	27.8	30.8	11.5	34.3	5.2	.41	4.4	15.5
Ohio 38-70	29.2	29.2	12.9	40.1	5.0	.34	4.6	13.6
Ohio 15-70	28.4	31.8	12.8	38.2	5.1	.38	4.5	17.4

Table III - 1971 Tomato Cultivar Evaluation Grade and Objective Evaluation of Whole Tomatoes

Cultivar	pH	% TA	Drained Weight	Wholeness	Color	Defects	TS	Grade
Chico III	4.5	.339	17	19	27	28	91	A
Ohio 21-70	4.45	.384	17	19	28	27	91	A
Ohio 28-70	4.5	.384	15	18	26	24	83	B
Ohio 20-70	4.45	.384	17.5	18.5	28.5	27.5	92	A
Mars	4.43	.426	16	18.5	26.5	26.5	87.5	B
CS 290	4.5	.422	17	19	28	28	92	A
Ohio 38-70	4.55	.390	17	18	27	27	89	B
Ohio 15-70	4.5	.346	18	20	29	29	96	A

Table IV - 1971 Tomato Juice Evaluation - Objective Quality and Chemical Analysis

	Cultivar							
	Chico III	Ohio 21-70	Ohio 28-70	Ohio 20-70	Mars	CS 290	Ohio 38-70	Ohio 15-70
Viscosity (Sec.)	43.9	38.2	41.6	41	39	42.2	36.8	39.1
Agtron F	37	32.5	35	34	28	29	29.5	27.5
Hunterlab L a b	26.8 25.2 12.7	25.3 25.2 12.5	26.2 26.0 13.1	25.4 25.5 12.4	23.5 24.8 11.7	24.2 25.5 11.9	24.2 24.8 12.3	23.4 24.1 11.7
% SS	5.7	5.7	5.5	5.4	5.5	6.1	6.1	5.7
pH	4.38	4.45	4.38	4.4	4.48	4.43	4.5	4.35
% Citric Acid	.416	.416	.464	.461	.363	.400	.394	.451
Vitamin C	15.75	14.18	14.00	13.30	14.88	12.52	11.82	15.58
Color (30)	28	28.5	27.5	28	28	28.5	27.5	28.5
Consistency (15)	15	15	15	15	15	15	15	14
Defects (15)	15	15	15	15	15	15	15	15
Flavor (40)	37	37.5	37.5	37	37.5	36	35.5	37.5
Total Score	95	96	95	95	95.5	94.5	93	95
Grade	A	A	A	A	A	A	A	A

EFFECTS OF FOOD ADDITIVES ON THE QUALITY OF CANNED TOMATOES

by

Wilbur A. Gould, John Mount, Jacquelyn Gould,
Louise Howiler, and James Black

A study using several cultivars was undertaken to show the effects of food additives on quality of canned tomatoes. In this study, several cultivars were machine harvested, bulk handled in water plus 500 ppm chlorine dioxide, and in dry bulk boxes. They were hauled from Hoytville to Columbus, approximately 100 miles, and held 12 hours following harvest prior to canning.

The tomatoes were washed, lye peeled (18% caustic soda and Faspeel at 200°F. for 20 seconds), rinsed in water, acid dipped (1% citric acid), and trimmed if necessary. The tomatoes were filled into cans containing 2 ounces of tomato juice, and with the FMC hand packed filler, 10-10½ ozs. of tomatoes were packed into the cans. Three or more lots were packed from each cultivar. The lots varied as follows:

(1) Salt only (21 grains sodium chloride and 9 grains calcium chloride).

(2) Salt as above, plus 0.3% citric acid.

(3) Salt and acid as above, plus 3% sugar.

The filled tomatoes were exhausted in an A. K. Robins steam exhaust box for 4 minutes, steam flow closed (17 psi) with a 006 American Can Co. closing machine, and still retort processed for 20 minutes at 1-2 psi free flowing steam. They were water cooled for 20 minutes and warehoused for three months at room temperature prior to grading according to the U. S. Standard for Grades of Canned Tomatoes.

In general, the effects of adding citric acid and citric acid plus sugar had little or no effect on total scores or grade changes in canned tomatoes. The acid will decrease the pH and increase the titratable acidity (TA) and under normal process assure sterility of high pH - low acid tomatoes. The effect of adding acid alone may uniformly change the flavor. Thus, the reason for adding sugar. Although the cultivars vary in inherent pH and total acid, adding sufficient acid to drop the pH 0.3 to 0.5 units and adding approximately 3% sugar should assure that the product can be commercially sterilized using the same basic processes.

Table 1 - Effect of Additives on Quality of Canned Tomatoes - 1971

Cultivar	Salt	Acid	Sugar	pH	TA	Drained Weight	Wholeness	Color	Absence of Defects	Total Score	Grade
Chico III	X			4.5	.339	17	19	27	28	91	A
	X	X		4.0	.762	16	18	27	27	88	B
	X	X	X	3.8	.851	16	20	29	28	93	A
Ohio 21 70	X			4.45	.384	17	19	28	27	91	A
	X	X		3.9	.845	15	20	28	28	91	B
	X	X	X	3.9	.819	15	19	28	28	90	B
Ohio 28-70	X			4.5	.384	15	18	26	24	83	B
	X	X		3.7	1.114	14	18	27	26	85	B
	X	X	X	3.9	.896	15	18	24	22	79	C
Ohio 20 70	X			4.45	.384	17.5	18.5	28.5	27.5	92	A
	X	X		3.8	1.047	15.5	19	27	26	87.5	B
	X	X	X	3.83	1.040	15.5	19	29.5	28.5	92.5	A
Mars	X			4.43	.426	16	18.5	26.5	26.5	87.5	B
	X	X		3.8	1.021	16.5	17.5	26	26.5	86.5	B
	X	X	X	3.8	.944	15	18	25.5	27	86.5	B
Average	X			4.47	.383	16.5	18.6	27.2	26.6	88.9	B
	X	X		3.84	.958	15.4	18.5	27.0	26.7	87.6	B
	X	X	X	3.85	.910	15.3	18.8	27.2	26.7	88.0	B

EFFECT OF STORAGE TEMPERATURE ON SHELF LIFE OF ASCORBIC ACID FORTIFIED TOMATO JUICE

by

Gerald A. Pope and Wilbur A. Gould

INTRODUCTION

The USDA has ordered fortified tomato juice for the Needy Families Program and the FDA may permit ascorbic acid as an optimal ingredient. To meet possible requirements for nutrient labeling, the fate after processing of high levels of ascorbic acid in tomato juice is being studied at several storage temperatures.

METHOD

Eight tomato cultivars were grown and havvested at the Ohio Agricultural Research and Development Center - Northwestern Branch, Hoytville, Ohio and transported in water to the OSU Food Processing Pilot Plant in Columbus. Six cultivars were havvested on two separate days and two were harvested once. The tomatoes were washed, chopped, hot extracted at 190°F., and the juice was pasteurized at 250°F. The hot juice was filled from an eight gallon filler bowl to which was added 0, 20, 40, 60, or 80 ml. of a solution of 90 gm. ascorbic acid in 500 ml. tomato juice. The added solution increased the ascorbic acid content by 0, 12, 24, 34, or 48 mg/100 ml. juice, re pectively. The juice was then filled into No. 303 fruit enameled lined cans, sealed, coded, and cooled. Each fortification level was divided into five lots to be stored at 35°, 55°, 68°, 88°, or 108°F. Samples of the raw product and processed juice were assayed for ascor ic acid content. After three months storage two replicates of each lot were also assayed.

Ascorbic acid content was determined photometrically. 10 ml. tomato juice was extracted with 90 ml. 1% metaphosphoric acid and filtered. 10 ml. of the extracted solution was titrated with 10 ml. of standard 2.6 dichlorophenylinodophenol solution and the absorbance recorded at 520 mm. Ascorbic acid was read from a standardized curve.

Vacuums and headspace were measured in all cans.

This project is being contined and samples will be assayed at 6 months and 9 months storage.

RESULTS

The samples all had vacuums averaging 10 inches. Headspace was well within tolerance for all cans.

Loss due to Processing: Ascorbic acid content following processing was 100% of the content assayed in raw tomatoes. All calculations were from initial ascorbic acid levels, shown in Table I, recorded immediately after processing.

Loss due to Storage: Juice refrigerated three months at 35°F. and 55°F. retained essentiall 100% of the ascorbic acid present following processing. There was only minor variations among cultivars and among fortification levels. Lowest retention at refrigerated temperatures was 94% for the highest fortification level (48 mg/100 ml. juice) at 55°F.

Room temperature, 68°F., storage produced lower retention in all cultivars. The control lot and the 12, 24, 2nd 36 mg. fortification lots retained 94% of processed ascorbic acid with a range from 92-95% for all cultivars. The highest fortification level retained lower percentage consistantly for the 8 cultivars with 81% on an average.

High temperature storage depleted ascorbic acid most rapidly. Retention of control, 12, 24, and 36 mg. lots was 90% at 88°F. with a range of 85% for the 36 mg. lot to 93% for the control. Retention in the 48 mg. lot was again lower with retaining 67% of processed acid at 88°F. Depletion was greatest at 108°F. storage and averaged 70% retention for control and three fortification levels with a range from 69-73%. The 48 mg. fortification level at 108°F. retained only 54% of the processed ascorbic acid.

<u>CONCLUSIONS AFTER 3 MONTHS STORAGE</u>

1. Percent retention of ascorbic acid in lots of equal fortification and stored at the same temperature was consistent for all cultivars and harvests.

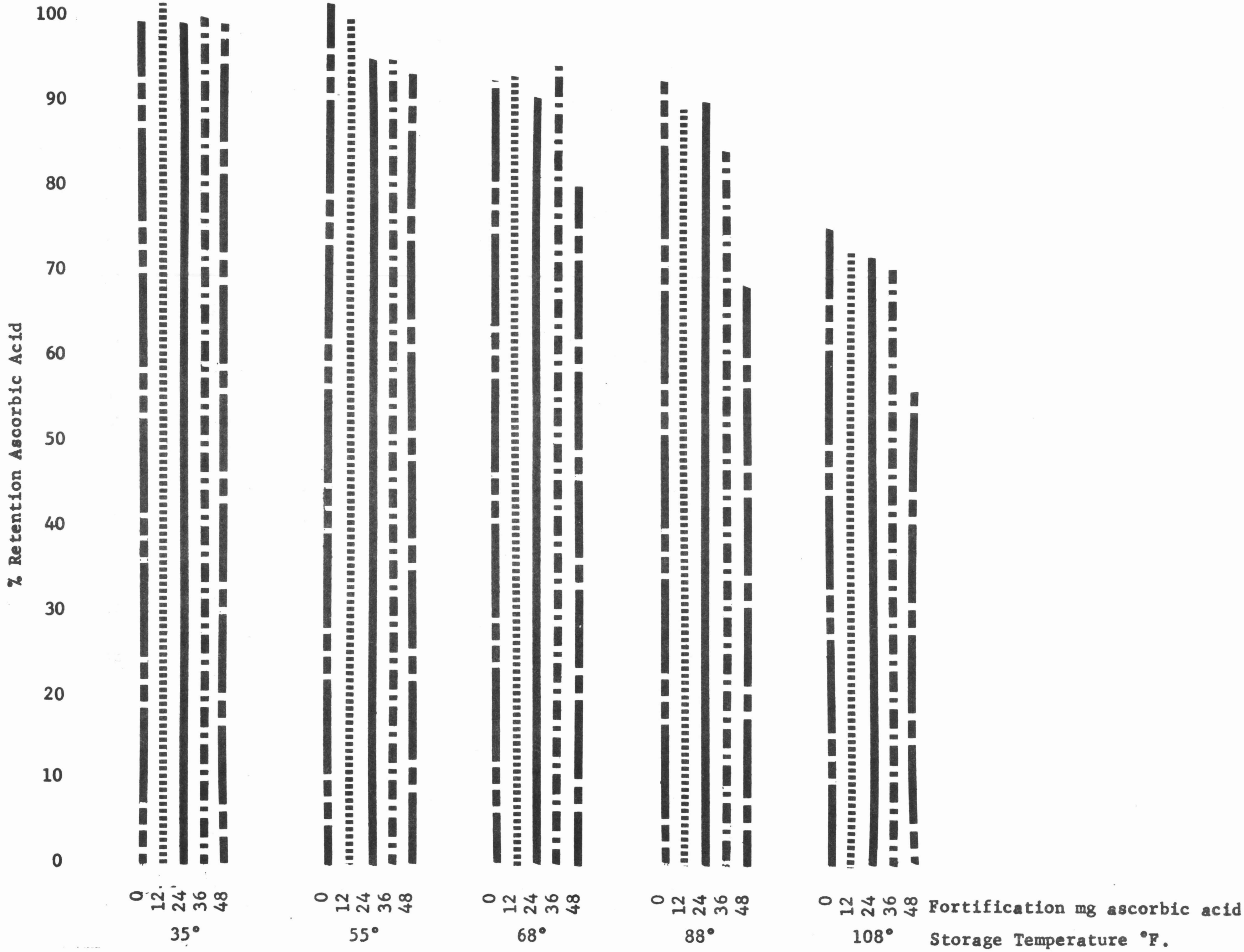
2. Retention was 100% at refrigerated temperatures and declined slightly at romm temperature to 93% and at 88°F. to 90%. Storage at 108°F. produced rapid depletion to 70% retention.

3. Fortification levels had no effect on percent retention at refrigerated storage temperatures. Room temperature and heated storage made visible lowered percent retention in higher fortification levels.

Table I - Raw and Initial Processed Ascorbic Acid Content of Tomato Juice

		mg Ascorbic Acid Fortification/100 ml Tomato Juice				
Cultivar	Raw	0	12	24	36	48
Chico III	13.5	13.7	22.0	38.2	45.3	49.0
Ohio 2170	12.5	15.5	29.4	33.6	57.3	54.9
Ohio 2870	17.5	17.0	28.2	41.1	55.2	84.5
Ohio 2070	15.0	17.5	31.9	41.3	50.0	78.0
Mars	16.5	19.0	26.0	46.0	54.0	86.0
CS 290	16.5	15.0	24.2	41.0	55.0	76.5
Ohio 3870	17.0	17.1	32.0	38.0	54.5	82.0
Ohio 1570	17.5	17.5	29.6	40.7	51.5	68.5
$\bar{X}$	15.7	16.0	30.5	40.0	52.8	72.4

RETENTION OF ASCORBIC ACID IN FORTIFIED TOMATO JUICE AFTER 3 MONTHS STORAGE



SURVEY OF WASTE DISPOSAL PRACTICES OF OHIO TOMATO PROCESSORS

by

J. R. Geisman

The food industry in the United States processes over 26 million tons of raw product annually (3). The value of the finished product accounts for about ten percent of the gross national product. However, the strength of the waste streams from food processing accounts for 20 percent of the Biological Oxygen Demand (BOD) of all wastes in the United States (2). The disparity between value and waste strength has resulted in increased efforts to reduce wastes from the processing industry.

The solid wasted generated by food processing totals nearly ten million tons annually. The food industry has an excellent record of by-product usage for approximately 79 percent of the solid waste. The remaining 21 percent of two million tons are disposed of as wastes. Of the solids wastes, vegetables contribute slightly more then half (1.1 million tons). Tomatoes produce a small volume of solids waste but are processed in such quantities that they generate about 40% of the solid waste from vegetables.

In Ohio the tomato is one of the most important vegetables for processing. According to USDA statistics (4) 545,650 tons of tomatoes were processed in Ohio in 1970. Tomatoes wastes range from five to ten percent of the weight of raw product. This means that the waste from tomatoes processed in Ohio is approximately 41,000 tons.

In 1970, there were 135 licensed canneries in Ohio. Of this total, 32 canneries process tomato products. These processors were surveyed to determine the "State-of-theArt" of tomato waste disposal practices in Ohio. It should be noted that 11 additional licensed canneries produce spaghetti sauce in Ohio. However, these plants handle very little, if any, raw product and were not included in the survey for that reason.

The questionnaire was designed to thoroughly cover a broad range of products, manufacturing practices and waste treatment techniques. Information was also obtained on water usage, raw product washing, in-plant cleaning and sanitizing procedures and space was provided for detailing any waste treatment problems which may have been encountered.

The survey questionnaires were mailed in duplicate with the duplicate to be retained for reference. It should be noted that responders were to complete only the portions of the questionnaire applicable to their operation.

Sixteen questionnaires were completed for a response of 50%. The returns were considered representative of the industry since the total tons processed varied from 700 to 22,000 and the number of products varied from one to five. The types of products processed and percent responders manufacturing each product are shown in Table I.

Some of the more important aspects covered by the questionnaire are reported below.

The source of water was determined and is reported in Table II. It was interesting to note that 50% of those responding had one source of water and 50% had two sources.

Water usage varied but was somewhat related to volume of raw product handled. Reuse of water also varied widely from a low of 0 to high of 60 percent of the volume.

The type of washing system for raw stock was variable. None of the responders depended on a single type of washing system. These reults are reported in Table III.

The method of waste disposal was also determined. One method of disposing of wastes was reported by 31.25% of those responded, and all the other respondents utilized more than one method. The results are reported in Table IV.

It is not suprising that spray irrigation is a prominent means of disposing of tomato wastes in Ohio. Much of the original research was conducted here by Dr. H. D. Brown (1).

From the results obtained by this survey it is apparent that continuing research is needed on waste disposal. One areafor further investigation is that of segregating wastes prior to treatment and disposal. Research is currently under way on this aspect.

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TABLE I - PRODUCT AND PERCENT OF PROCESSORS MANUFACTURING EACH PRODUCT

PRODUCT	PERCENT*
Whole Tomatoes	56.25
Tomato Juice	31.25
Catsup	37.50
Puree	18.75
Chili Sauce	18.75
Barbeque Sauce	12.50
Pizza Sauce	6.25

TABLE II - SOURCE OF WATER USED AT THE PLANT FOR PROCESSING AND PERCENT DISTRIBUTION OF SOURCES UTILIZED

SOURCE	PERCENT*
City	50.00
Private Well	50.00
Lake	6.25
River	6.25

TABLE III - TYPE OF WASHING SYSTEM UTILIZED AND PERCENT UTILIZING EACH TYPE

TYPE OF WASHING SYSTEM	PERCENT*
Flume	75.00
Flood	6.25
Soak	37.50
Spray	56.25
Agitated Soak	31.25

TABLE IV - TYPE OF WASTE DISPOSAL SYSTEM AND PERCENT UTILIZING EACH TYPE

TYPE OF WASTE DISPOSAL SYSTEM	PERCENT*
City Sewer	31.25
Spray Irrigation	50.00
Aerobic Lagoon	25.00
Anaerobic Lagoon	6.25
River	6.25

* Multiple response makes the total greater than 100.

EVALUATION OF SNAP BEAN VARIETIES FOR PROCESSING

by

Wilbur A. Gould, Jacquelyn Gould, and Roberta Topits*

Ten varieties of snap beans were grown on the Horticultural Farm at The Ohio State University. The beans were planted in 200 foot rows, 36 inches apart with the seed placed two to three inches apart in the row depending on seed size.

At harvest, the plants were pulled and the pods removed by hand. They were transported immediately to the Fruit and Vegetable Processing and Technology Pilot Plant. The beans were mechanically snipped, size graded, spray washed, water or steam blanched and hand packed twelve ounces into No. 303 plain tin cans. Two size grades were used, 1-3 and 4-6, the latter were cut into pieces 1 to $1\frac{1}{2}$ inches long, the smaller size grade were packed as whole beans. The whole beans were steam blanched for 3 minutes, and the cut beans were water blanched at 170°F. for 3 minutes. Both lots were water cooled prior to inspection and filling.

The canned snap beans were covered with boiling distilled water and a thirty-grain sodium chloride tablet was added to the can. The cans were exhausted for four minutes, steam flow closed (at 15 psi) and processed at 240°F. for 20 minutes.

The frozen snap beans were filled into freezer bags, sealed, coded, frozen in a single contactfreezer (-40°F.) and stored at 0°F.

Quality was determined as follows (the results as reprted in the following tables are the average values for this harvest where applicable):

Number of plants - The actual number of plants in 200 feet were pulled and counted for each of the harvests.

Yield - The beans were weighed to determine the gross yield in pounds for the number of plants in 200 foot rows.

Number of pods per pound - The number of pods in a one-pound field run sample was counted.

Percent sieve size - Sieve size was detemined by measuring the diameter of the pod perpendicular to the sutures. The sieve sizes of a one-pound field run sample were determined and weighed. The data are shown by count, percentage by count and by weight for each sieve size.

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*The assistance of Louise Howiler, Shirley Perryman for determining the fiber content, and the students in Horticulture 641 class for processing the samples, is gratefully acknowledged.

Pod length - Pod length was determined by evaluating 20 pods as to average length reported in inches.

Percent by weight seeds - Determined on fresh, canned, and frozen product and reported by sieve size. For determining percent by weight seeds, 100 grams of pods for each sieve size were deseeded and the seeds weighed.

Texture - Determined on GOSUT texturometer using several pods of each sieve size to arrive at the average value. Results are reported directly in GOSUT texturometer values.

The grade for the canned and frozen products by the respective attributes of quality was determined in accordance with the U.S. Standards for Grades of Canned and Frozen Snap Beans. The actual score points assigned each of the attributes of quality are recorded by sieve size for each of the varieties.

% Fiber - % Fiber was determined by both the Official Food and Drug Method and by the Blendor Method. (Both values agreed within experimental error, therefore the average is shown. All values are far below the maximum limit of 0.15%.)

Table I - Snap Bean Evaluation - 1971

Variety Seed Source & Lot no.	No. Growing Days	No. Plants 200'	Yield oz./ Plant	No. Pods/ lb.	Sieve Size	Count no./ lb.	Count %	% by Weight	Av. Length in.	Texture	% Fiber	% Seeds
Slimgreen	64	1041	.51	147	1	272	5	1.5	3	3	-	-
Rodger 03102					2	157	11.6	7.8	3.5	8	-	-
					3	143	28.1	25	4	14	.035	5.1
					4	117	35.5	35.9	4	25	.046	9.1
					5	91	11.6	25	4.5	26	.092	15.2
					6	81	5	7.8	4.5	35	-	-
Greenpod 136	65	660	1.09	122	1	457	27	6.3	2.5	4	-	-
Rodger 70417					2	184	14.8	9.4	3.5	10	-	-
					3	117	11.5	4.7	3.75	15	.018	2.2
					4	86	25.4	34.4	4.5	21	.028	4.2
					5	70	12.3	20.3	4.75	25	.027	3.8
					6	59	9	18.7	5	27	.037	6.2
Early Gallatin	63	1162	.87	114	1	325	15.8	4.7	3	8	.037	1.1
Rodger 70152					2	182	14.9	9.4	3.75	14	.034	2.5
					3	136	14.9	12.5	3.75	18	.039	3.1
					4	96	28.9	34.4	4	21	.062	3.8
					5	78	12.3	18.7	4.25	27	.056	5.3
					6	72	13.2	21.9	4.75	30	.058	6.2
Greenpod 317	64	715	.31	144	1	327	20.8	9.4	3.25	5	-	-
Rodger 03075					2	184	20.1	15.6	3.75	8	-	-
					3	129	16.7	17.2	4.5	15	.062	2.7
					4	103	23.6	31.3	4.5	22	.082	4.8
					5	86	11.1	17.2	4.25	30	.111	6.7
					6	75	6.9	15.6	4.75	35	.076	10.5
Greenpod 467	59	800	1.04	127	1	312	35.4	12.5	3	8	.016	-
Rodger 70339					2	163	19.7	15.6	3.75	15	.020	-
					3	117	10.2	14.1	4.25	18	.025	-
					4	90	13.4	20.3	4.75	23	.027	-
					5	71	13.4	21.9	4.75	28	.042	-
					6	61	8.7	20.3	5	32	.048	-

Variety Seed Source & Lot no	No. Growing Days	No. Plants 200'	Yield oz./ Plant	No. Pods/ lb.	Sieve Size	Count no./ lb.	Count %	% by Weight	Av. Length in.	Texture	% Fiber	% Seeds
Wondergreen 492 Rodger 68494	63	1450	.77	126	1	346	7.9	1.5	2.25	-	-	-
					2	139	10.3	3.1	2.5	6	-	-
					3	158	23.8	15.6	3.5	12	.034	4.3
					4	112	39.7	45.3	4	20	.034	5.1
					5	90	15.9	25	3.5	20	.030	6.1
					6	85	2.4	9.4	3.5	34	-	-
Astro Asgrow 86177	63	945	.58	121	1	-	13.2	6.2	2.75	6	-	-
					2	-	23.1	17.2	3.25	-	-	-
					3	116	20.7	21.9	3.75	18	.045	3.6
					4	95	31.4	37.4	3.75	22	.058	6.8
					5	74	9.9	15.6	3.75	32	.060	8.5
					6	-	1.7	3.1	4	-	-	-
Bush Blue Lake Asgrow 63613	65	269	.77	106	1	-	2.8	1.5	3.25	2	-	-
					2	164	18.9	10.9	3.5	8	.017	1.4
					3	121	28.3	25	4.25	14	.026	2.4
					4	90	34.9	40.6	4.75	24	.022	2.5
					5	89	10.5	14.1	5	27	.032	3.8
					6	-	4.7	7.8	5.5	32	-	-
Midas Asgrow 46418	65	768	.63	136	1	414	3.7	1.5	2.75	5	-	-
					2	214	9.6	6.2	3.25	10	-	-
					3	166	18.4	14.1	3.25	13	.018	2.9
					4	121	46.3	50	4	24	.027	6.3
					5	110	17.6	21.9	4	31	.035	10.0
					6	91	4.4	6.2	4.5	33	.047	13.8
Maestro Asgrow 66334	65	344	1.26	130	1	427	17.7	3.1	3	6	-	-
					2	192	12.3	9.4	3.25	9	-	-
					3	142	19.2	18.7	4	14	.031	3.6
					4	116	35.4	37.4	4.5	21	.056	5.8
					5	101	13.1	17.2	4.5	25	.125	13.3
					6	84	9.2	14.1	4.5	27	.127	21.5

Table II - Canned Snap Bean Evaluation - 1971

Variety	Sieve Size	Liquor	Color	Absence Defects	Char-acter	Total Score	Grade	% Fiber	% Seeds
Slimgreen	1 - 3	10.0	15.0	35.0	36.0	96.0	A	.030	7.1
	4 6	9.0	15.0	35.0	33.0	92.0	B	.038	11.1
Greenpod 136	1 - 3	10.0	13.0	35.0	38.0	96.0	A	.018	3.4
	4 - 6	10.0	14.0	35.0	36.0	95.0	A	.028	5.5
Early Gallatin	1 - 3	10.0	14.0	35.0	39.0	98.0	A	.028	4.8
	4 - 6	10.0	13.0	35.0	37.0	95.0	A	.036	5.5
Greenpod 317	1 - 3	10.0	14.0	35.0	38.0	97.0	A	.020	4.4
	4 - 6	10.0	13.0	35.0	35.0	93.0	B	.024	7.7
Greenpod 467	1 - 3	10.0	14.0	35.0	36.0	95.0	A	.021	3.9
	4 - 6	10.0	13.0	35.0	38.0	96.0	A	.024	6.2
Wonder Green	1 - 3	10.0	14.0	35.0	38.0	97.0	A	.023	6.2
	4 - 6	10.0	14.0	35.0	38.0	97.0	A	.025	6.2
Bush Blue Lake	1 - 3	10.0	13.0	35.0	37.0	95.0	A	.027	2.8
	4 - 6	10.0	14.0	35.0	39.0	98.0	A	.028	3.3
Astro	1 - 3	10.0	13.0	35.0	36.0	94.0	A	.025	4.2
	4 - 6	10.0	14.0	35.0	35.0	94.0	B	.027	7.9
Midas	1 - 3	10.0	13.0	35.0	40.0	98.0	A	.031	4.2
	4 - 6	10.0	15.0	35.0	34.0	94.0	B	.042	9.5
Maestro	1 - 3	10.0	13.0	35.0	36.0	94.0	A	.033	5.5
	4 - 6	10.0	13.0	35.0	37.0	95.0	A	.056	8.6

Table III - Frozen Snap Bean Evaluation - 1971

Variety	Sieve Size	Color	Absence Defects	Char-acter	Total Score	Grade	% Fiber	% Seeds
Slimgreen	1 - 3	20.0	40.0	40.0	100.0	A	.024	5.7
	4 - 6	18.0	40.0	35.0	93.0	B	.044	7.6
Greenpod 136	1 - 3	20.0	40.0	40.0	100.0	A	.024	5.1
	4 - 6	17.0	40.0	36.0	93.0	B	.033	7.5
Early Gallatin	1 - 3	19.0	40.0	39.0	98.0	A	.032	4.3
	4 - 6	17.0	40.0	35.0	92.0	B	.055	7.8
Greenpod 317	1 - 3	18.0	40.0	39.0	97.0	A	.018	3.7
	4 - 6	16.0	40.0	37.0	93.0	B	.025	7.4
Greenpod 467	1 - 3	19.0	40.0	36.0	95.0	A	.029	4.7
	4 - 6	15.0	40.0	34.0	91.0	C	.039	7.4
Wonder Green	1 - 3	19.0	40.0	39.0	98.0	A	.022	5.9
	4 - 6	17.0	40.0	36.0	93.0	B	.035	7.7
Astro	1 - 3	19.0	40.0	38.0	97.0	A	.024	5.5
	4 - 6	17.0	40.0	35.0	92.0	B	.041	9.0
Bush Blue Lake	1 - 3	19.0	40.0	39.0	98.0	A	.019	2.7
	4 - 6	17.0	40.0	38.0	95.0	B	.033	4.0
Midas	4 - 6	18.0	40.0	36.0	94.0	A	.038	13.6
Maestro	1 - 3	19.0	40.0	38.0	97.0	A	.031	5.7
	4 - 6	17.0	40.0	36.0	93.0	B	.055	5.5

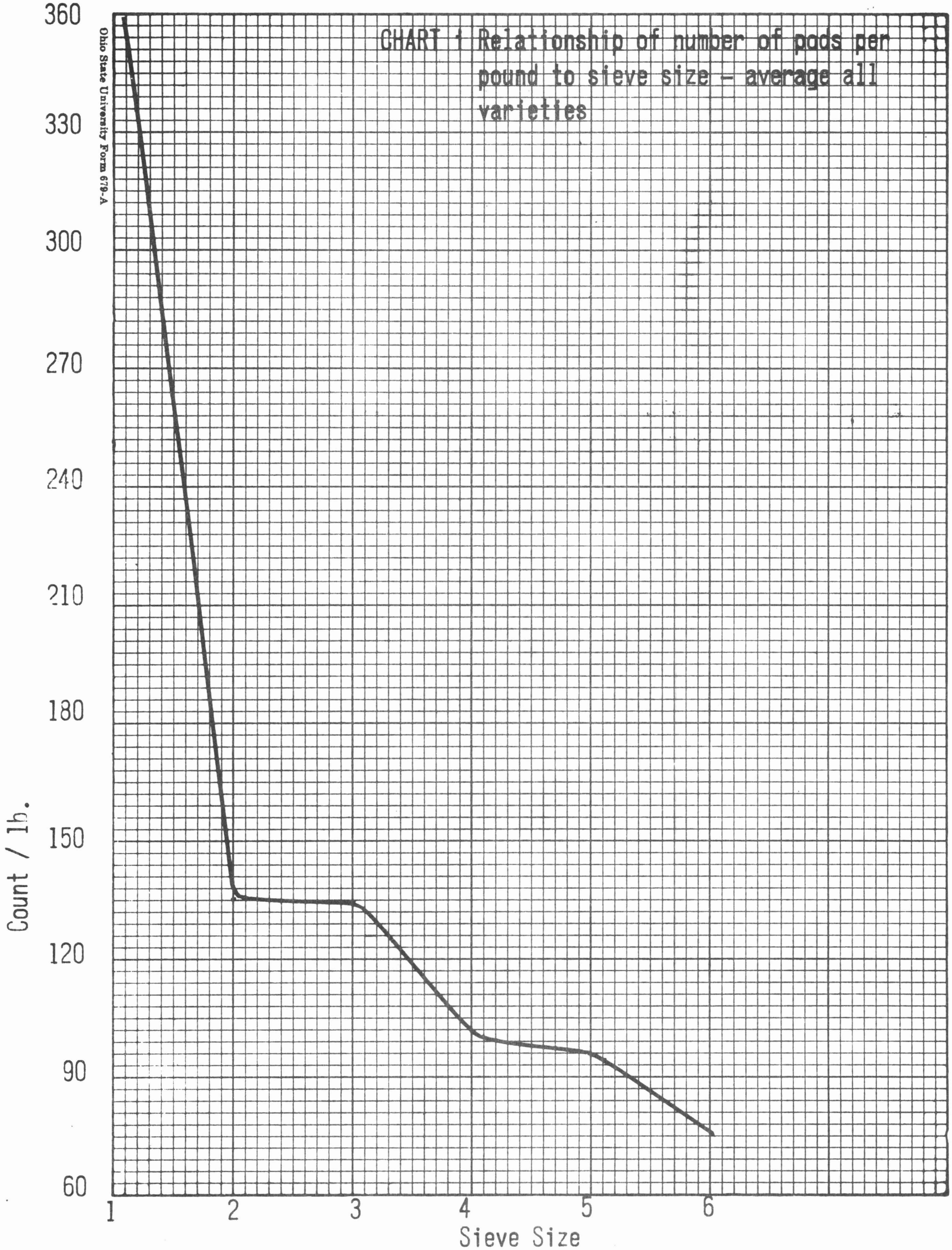


CHART I Relationship of number of pods per pound to sieve size - average all varieties
Ohio State University Form 679-A
Count / lb.
360
330
300
270
240
210
180
150
120
90
60
1
2
3
4
5
6
Sieve Size

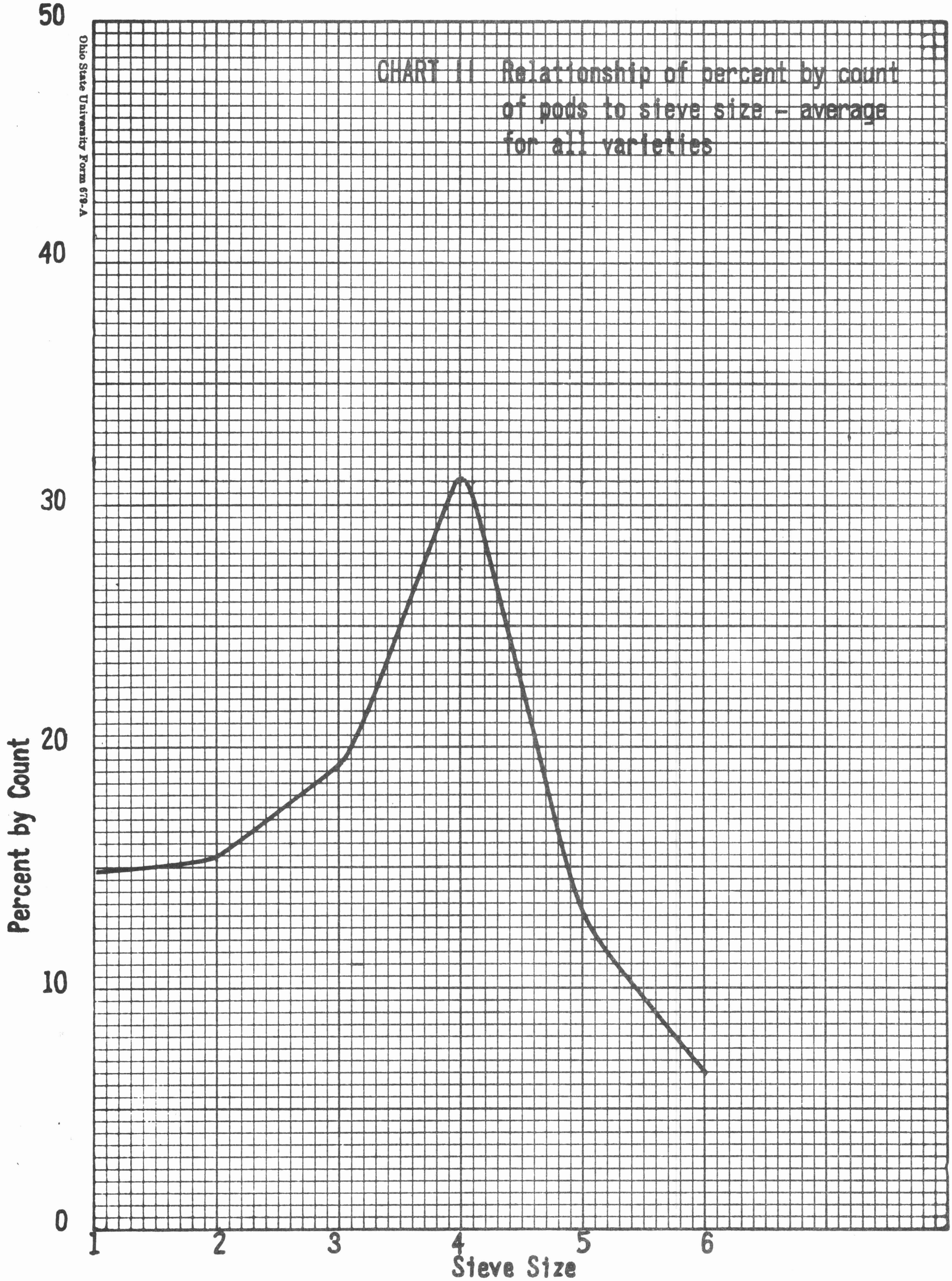


CHART II Relationship of percent by count of pods to sieve size - average for all varieties
Ohio State University Form 679-A
Percent by Count
50
40
30
20
10
0
1
2
3
4
5
6
Sieve Size

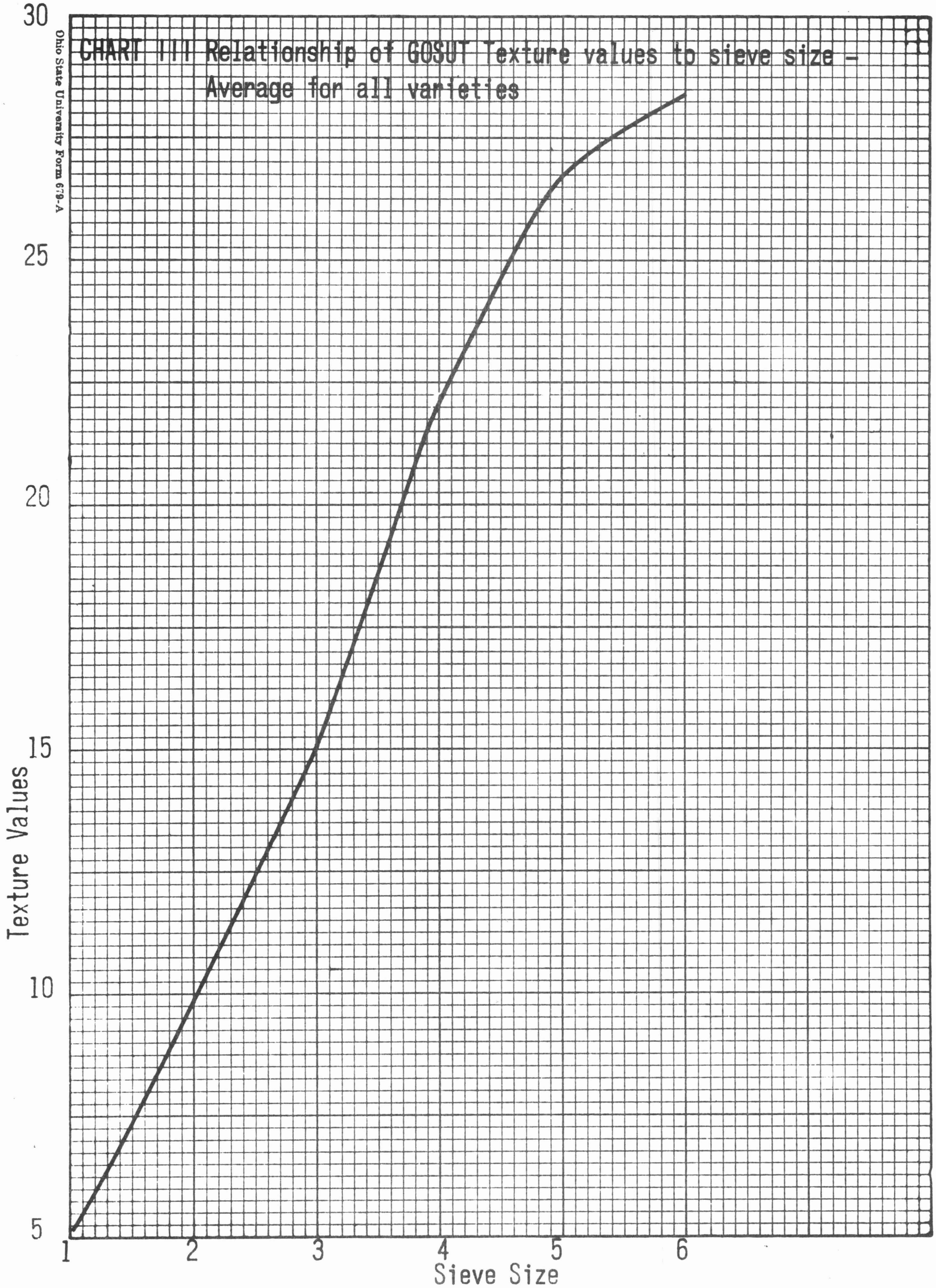


CHART III Relationship of GOSUT Texture values to sieve size - Average for all varieties
Texture Values
30
25
20
15
10
5
Sieve Size
1
2
3
4
5
6
Ohio State University Form 678-A

THE EFFECT OF VARIETY, SIZE, AND FERMENTATION TEMPERATURE ON THE QUALITY ATTRIBUTES OF CUCUMBER PICKLES

by

Gary Flinn and Wilbur A. Gould

Three varieties of cucumbers, grown on the Horticulture Farm at The Ohio State University, were used for this study. The three varieties were harvested three times, sized into two groups, and fermented at three different temperatures. An initial salt concentration of 30 degrees salometer was selected for the brine and was maintained for the first week of the fermentation process. After which time, the salometer was increased 2 degrees per week for 15 weeks.

VARIETIES	SIZE GROUPS	FERMENTATION TEMPERATURE
Bounty	A. midgets to medium	55°F
Pioneer	B. medium to extra large	70°F
Premier		85°F

Daily measurements made during the fermentation process included salometer readings, total acid of brine as lactic, and pH. The rate of acid formation is given in figure #1.

QUALITY EVALUATION

The quality evaluation made after the fermentation process included:

A. Subjective (0=poor - 10=perfect point scale)
   1. Color
      a. Internal (white to green)
      b. External (light green to green)
   2. Bloaters (poor to none)
   3. Internal firmness (poor to excellent)
   4. Slimness (poor to none)
   5. Over texture (poor to excellent)
   6. Seed size (large to small)

B. Objective color using Agtron E and reading on all three scales, that is, Red, Green, and Blue.

Preliminary observation indicates that little quality difference existed among varieties within a fermentation temperature. However, among fermentation temperatures the greatest variation in the data existed with regard to internal color. As indicated in Table #2, the cucumbers fermented at 85°F produced the most desirable internal color followed by the cucumbers fermented at 70°F and 55°F respectively. This is also supported by the data collected on internal color by use of the Wide Angle Agtron E. Average Red, Green, and Blue values for the three fermentation groups are as follows:

Table 1 - Agtron Color Values by Fermentation Temperature

	RED	GREEN	BLUE
55°F	18	11	6
70°F	17	15	12
85°F	8	20	10

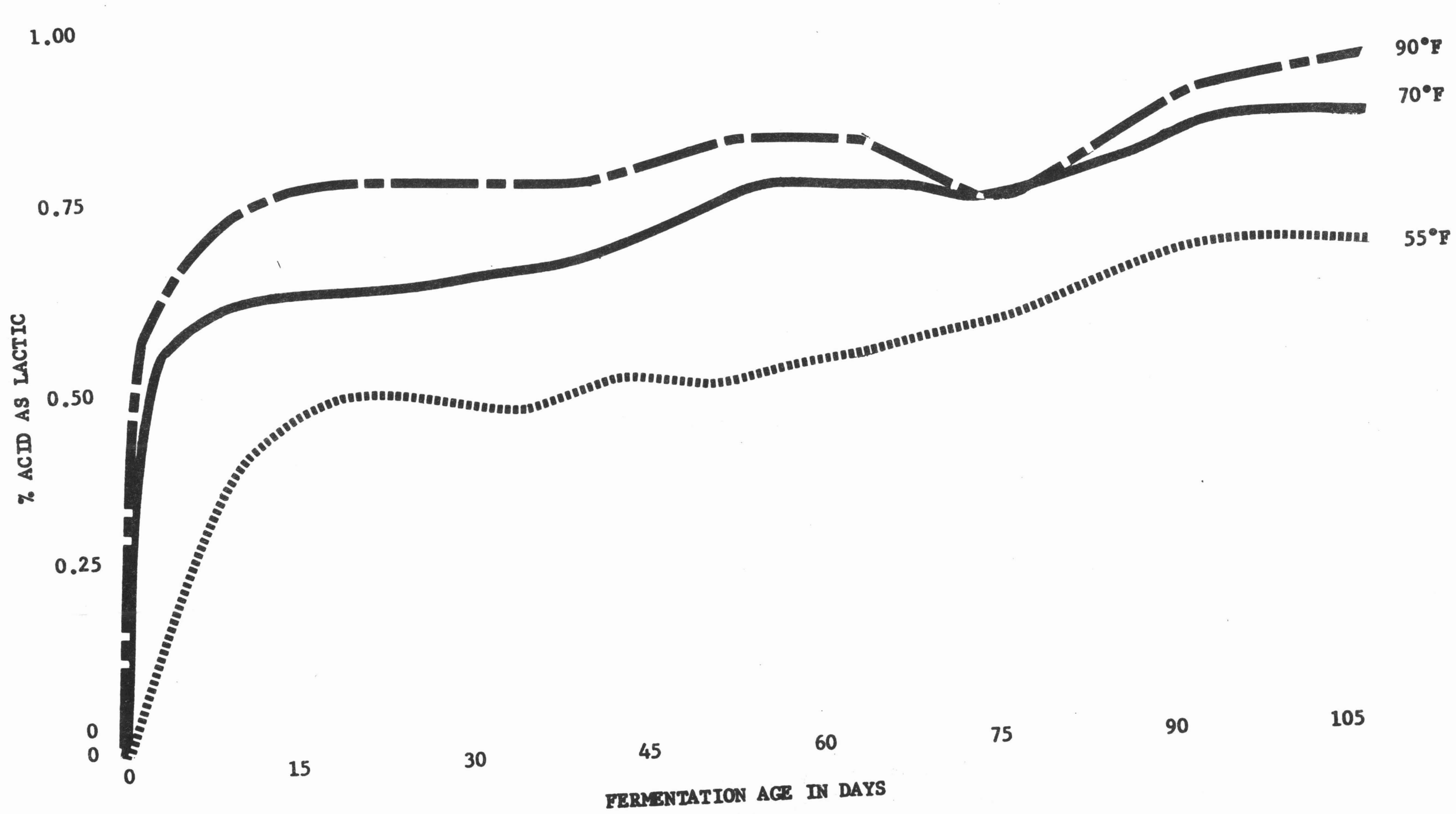
With regard to the two size classifications, little differences were observed in the final evaluation with the possible exception of the number of bloaters. The larger cucumbers were recorded as having a somewhat larger number of bloaters than did the smaller cucumbers.

TABLE 2 - SUBJECTIVE EVALUATION BY VARIETY, CUCUMBER SIZE, AND FERMENTATION TEMPERATURE

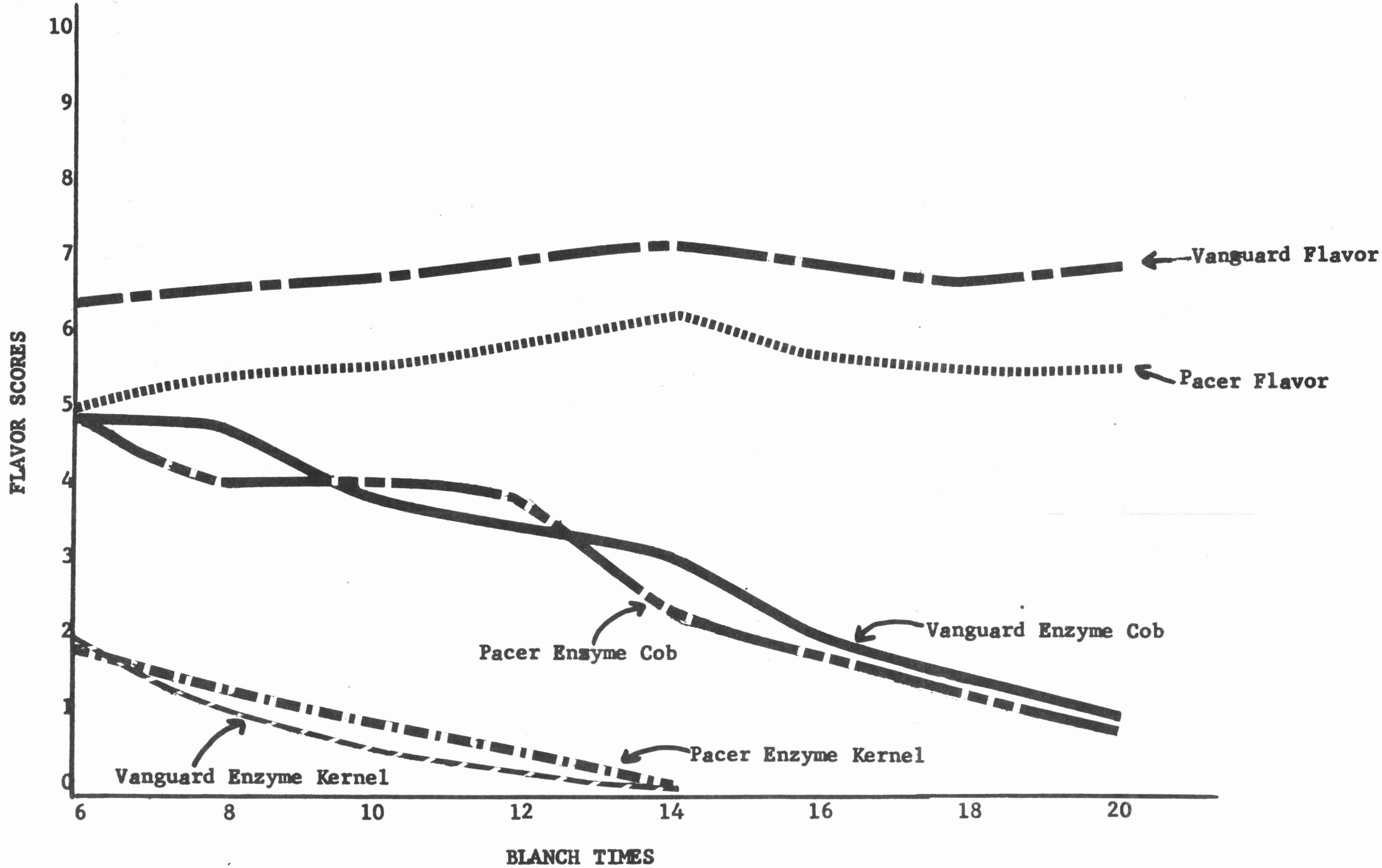
VARIETY	SIZE	TEMP °F	COLOR INTERNAL	COLOR EXTERNAL	BLOATERS	INTERNAL FIRMNESS	SLIMNESS	OVERALL TEXTURE	SEED SIZE	COMMENTS
Pioneer	A	55	3	9	9	9	9	9	9	Chalky internal color
		70	3	8	8	9	9	8	7	White dead gray
		85	6	8	9	9	5	9	9	Chalky internal color
	B	55	4	8	9	8	9	9	7	White gray internal
		70	4	8	9	9	8	9	8	Dead green gray
		85	7	7	7	7	9	9	7	Normal
Bounty	A	55	3	8	9	9	9	9	9	Normal
		70	3	7	9	8	7	8	8	Chalky gray white
		85	5	7	8	8	9	9	8	Normal
	B	55	2	6	9	8	9	9	7	White chalky
		70	7	9	8	9	9	9	6	Normal
		85	4	6	7	7	8	8	6	Dead gray
Premier	A	55	3	7	9	9	9	9	9	Chalky white
		70	3	6	9	8	8	8	8	Dead gray
		85	6	7	8	8	8	8	8	Normal
	B	55	3	8	8	8	9	9	7	Chalky
		70	8	8	9	9	9	9	8	Slimy
		85	6	7	8	8	7	6	7	Normal
	$\bar{X}$	55	3.0	7.7	8.8	8.5	9.0	8.8	8.0	
		70	4.7	9.2	7.7	8.7	8.3	8.5	7.5	
		85	5.7	7.0	7.8	7.8	7.7	8.2	7.5	

TABLE 2 - SUBJECTIVE EVALUATION BY VARIETY, CUCUMBER SIZE, AND FERMENTATION TEMPERATURE

VARIETY	SIZE	TEMP °F	COLOR INTERNAL	COLOR EXTERNAL	BLOATERS	INTERNAL FIRMNESS	SLIMNESS	OVERALL TEXTURE	SEED SIZE	COMMENTS
Pioneer	A	55	3	9	9	9	9	9	9	Chalky internal color
		70	3	8	8	9	9	8	7	White dead gray
		85	6	8	9	9	5	9	9	Chalky internal color
	B	55	4	8	9	8	9	9	7	White gray internal
		70	4	8	9	9	8	9	8	Dead green gray
		85	7	7	7	7	9	9	7	Normal
Bounty	A	55	3	8	9	9	9	9	9	Normal
		70	3	7	9	8	7	8	8	Chalky gray white
		85	5	7	8	8	9	9	8	Normal
	B	55	2	6	9	8	9	9	7	White chalky
		70	7	9	8	9	9	9	6	Normal
		85	4	6	7	7	8	8	6	Dead gray
Premier	A	55	3	7	9	9	9	9	9	Chalky white
		70	3	6	9	8	8	8	8	Dead gray
		85	6	7	8	8	8	8	8	Normal
	B	55	3	8	8	8	9	9	7	Chalky
		70	8	8	9	9	9	9	8	Slimy
		85	6	7	8	8	7	6	7	Normal


1.00
0.75
0.50
0.25
0
0
% ACID AS LACTIC
0
15
30
45
60
75
90
105
FERMENTATION AGE IN DAYS
90°F
70°F
55°F

GRAPH I - A COMPARISON OF AVERAGE FLAVOR SCORES WITH RELATIVE ENZYME ACTIVITY IN THE PACER AND VANGUARD CULTIVARS



PROGRESS REPORT ON FROZEN CORN-ON-THE-COB

by

James W. Swinehart and Wilbur A. Gould

Two sweet corn cultivars, Vanguard and Pacer, were evaluated to determine the influence of blanch time and frozen storage upon the quality of the frozen corn-on-the-cob after thawing and cooking. The corn-on-the-cob was stored for 12 months in 0° storage. Taste panel evaluations for flavor, color, and texture along with percent AIS, percent moisture, percent total solids and a qualitative enzyme test on both the corn kernels and a cross section of the corn ears were carried out after 4, 8, and 12 months storage.

The two cultivars were frozen on the cob in July 1970. They were husked, washed and trimmed, and sorted according to size of the ears. Three sizes were used: they were, size 1 - ears with a diameter of less than 1 3/4 inches; size 2 - ears with a diameter of 1 3/4 inches up to 2 inches; and size 3 - ears with a diameter greater than 2 inches. Twenty-four ears of each of the three size categories for each of the two cultivars were then blanched and cooled in water for equivalent times, the corn was packaged in groups of six ears, coded, and placed in a -40° freezer. After freezing, the corn was stored in a 0° freezer.

SUMMARY OF RESULTS

The results are shown on Tables I-IV and in Chart I.

PERCENT AIS

The Alsohol-Insoluble Solids (AIS) content increased as the ear diameter increased for both cultivars. The Grand Mean for percent AIS of Pacer was 24.48% as compared to 19.41% for Vanguard. These results indicate the Pacer cultivar is much more mature than the Vanguard cultivar.

PERCENT TOTAL SOLIDS

The percent Total Solids increased with increasing ear diameter in both the Pacer and Vanguard cultivars. The Grand Mean of Pacer was 29.43% compared to 25.45% for Vanguard. Thus, the Pacer cultivar is more mature than the Vanguard cultivar.

PERCENT MOISTURE

The percent moisture decreased in both cultivars as ear diameter increased. The Grand Mean of the Pacer cultivar was 68.60% compared to 73.90% in the Vanguard cultivar. Again, the Pacer cultivar was shown to be much more mature than the Vanguard cultivar.

QUALITATIVE ENZYME TEST

The data at 4, 8, and 12 months from the enzyme test from cross sections of the corn using a 0-5 point scale, showed that in both cultivars, a 20 minute blanch time was not sufficient for complete inactivation of enzymes in the cob. The enzyme activity was also shown to increase with increasing ear size and increased storage time.

The data at 4, 8, and 12 months from the enzyme test on the kernels of both cultivars, indicates that a 16 minute blanch time was sufficient for enzyme inactivation in the corn kernels. The data, also, showed an increase in enzyme activity with increasing ear size and storage time.

TASTE PANEL EVALUATION

In general, flavor scores decreased with increasing ear diameter over the 12 month period in both cultivars. The Pacer cultivar decreased in overall flavor while the Vanguard cultivar showed a slight increase in flavor during the 12 month period.

In comparing the flavor scores of each cultivar to blanching times, a significant result occurs. In each of the 4, 8, and 12 month taste panels, the highest flavor score for each cultivar occurs at a blanching time of 14 minutes. The flavor scores increase with an increased blanch time and reach a maximum at a blanch time of 14 minutes. At blanching times greater than 14 minute, flavor scores decrease.

The Vanguard cultivar was superior in terms of texture to the taste panel members. The texture scores of each cultivar decreased with increasing ear diameter during the 4, 8, and 12 month evaluation periods.

CONCLUSIONS

1. The data from the objective evaluations (%AIS, % Total Solids, % Moisture) indicates that the Pacer cultivar was too mature for use as frozen corn-on-the-cob. The Vanguard cultivar was also mature at ear sizes 2 and 3 for frozen corn-on-the-cob.

2. The qualitative enzyme test for the two cultivars indicates that a 20 minute blanch time is not sufficient for enzyme inactivation in the cob; but, that a 16 minute blanch time is sufficient for enzyme inactivation in the corn kernels. In both cultivars, enzume regenration was apparent in both the kernels and cob durin the 12 month storage.

3. The taste panel results show that the Vanguard cultivar had a superior flavor score when compared to the Pacer cultivar. This can be attributed in part, to the maturity differences between the two cultivars. The data also indicated the highest flavor scores occur at a blanch time of 14 minutes. Neither the enzymes in the kernels, nor the enzymes in the cob are inactivated at a 14 minute blanch time.

4. The texture of the Vanguard cultivar was also superior to that of the Pacer cultivar. This can be attributed to Pacer being the more mature cultivar. Texture scores were shown to increase with increasing ear size, thus, showing an increase in maturity with the larger ears.

5. The color of Pacer was scored higher than that of Vanguard. This can also be attributed to the Pacer cultivar being the more mature cultivar. The deeper yellow color occurs with increasing maturity. The taste panel members preferred a deeper yellow color over the lighter yellow color.

TABLE I - A COMPARISON OF AVERAGE % AIS, % TOTAL SOLIDS, AND % MOISTURE AT THE THREE EAR SIZES FOR THE PACER AND VANGUARD CULTIVARS

CULTIVAR	EAR SIZE	% AIS	% TOTAL SOLIDS	% MOISTURE
PACER	1	22.86	27.80	70.02
	2	24.79	30.10	68.08
	3	25.81	30.36	67.64
	$\bar{X}$	24.48	29.43	68.60
VANGUARD	1	16.30	22.03	75.93
	2	20.43	26.83	71.93
	3	21.50	27.50	73.86
	$\bar{X}$	19.41	25.45	73.90

TABLE II - A COMPARISON OF ENZYME COB AND ENZYME KERNEL ACTIVITY AT THE VARIOUS BLANCHING TIMES AND EAR SIZES FOR THE 4, 8, AND 12 MONTH PERIODS FOR PACER AND VANGUARD

EAR SIZE	BLANCH TIME	4 MONTHS				8 MONTHS				12 MONTHS			
		PACER		VANGUARD		PACER		VANGUARD		PACER		VANGUARD	
		ENZYME COB	ENZYME KERNEL	ENZYME COB	ENZYME KERNEL	ENZYME COB	ENZYME KERNEL	ENZYME COB	ENZYME KERNEL	ENZYME COB	ENZYME KERNEL	ENZYME COB	ENZYME KERNEL
1	6	4.50	2.00	5.00	1.00	4.70	2.50	5.00	1.50	5.00	2.75	5.00	2.75
	8	3.25	1.00	4.25	.50	4.00	1.10	4.50	1.25	4.25	1.25	5.00	2.75
	10	3.25	.50	2.00	.25	3.50	.70	3.00	1.00	4.00	1.00	4.25	1.75
	12	2.75	.25	1.50	.15	3.25	.35	2.50	.50	3.75	.50	4.00	1.00
	14	1.25	0	1.00	0	1.70	.10	2.00	.25	2.00	.25	3.75	.50
	16	.55	0	.50	0	1.00	0	1.00	0	2.00	0	2.00	0
	18	.50	0	.50	0	1.00	0	1.00	0	1.25	0	2.00	0
	20	-	-	.40	0	-	-	.50	0	-	-	1.00	0
2	6	4.75	2.00	4.75	1.00	4.80	2.15	4.80	1.75	5.00	2.35	5.00	2.75
	8	4.50	1.00	4.75	.50	4.70	1.25	4.75	1.50	4.85	1.50	5.00	2.25
	10	4.00	.50	3.50	.30	4.20	.70	4.00	1.00	4.50	1.00	4.50	1.50
	12	3.00	.20	3.50	.20	3.50	.25	3.75	.75	4.00	.50	4.00	1.00
	14	1.50	0	1.75	0	2.00	.20	3.00	.25	2.25	.38	4.00	.50
	16	1.25	0	1.00	0	1.50	0	1.50	0	1.75	0	2.25	0
	18	1.00	0	.55	0	1.20	0	1.50	0	1.49	0	2.00	0
	20	.80	0	.60	0	1.00	0	1.00	0	1.25	0	1.25	0

		4 MONTHS				8 MONTHS				12 MONTHS			
		PACER		VANGUARD		PACER		VANGUARD		PACER		VANGUARD	
EAR SIZE	BLANCH TIME	ENZYME COB	ENZYME KERNEL	ENZYME COB	ENZYME KERNEL	ENZYME COB	ENZYME KERNEL	ENZYME COB	ENZYME KERNEL	ENZYME COB	ENZYME KERNEL	ENZYME COB	ENZYME KERNEL
3	6	5.00	1.50	4.75	1.00	5.00	1.50	4.75	2.50	5.00	2.00	5.00	3.25
	8	4.00	1.00	4.50	.70	5.00	1.25	4.50	2.00	5.00	1.50	5.00	2.25
	10	4.75	.50	4.00	.50	4.80	.75	4.25	1.00	5.00	1.00	4.75	1.50
	12	4.25	.10	3.50	.10	4.50	.35	3.70	.50	5.00	.50	4.50	1.00
	14	3.25	0	3.25	0	3.50	.25	3.50	.25	3.75	.50	4.00	.50
	16	2.00	0	2.00	0	2.20	0	2.50	0	2.50	0	3.75	0
	18	1.25	0	1.00	0	1.50	0	1.50	0	1.74	0	2.75	0
	20	1.00	0	1.00	0	1.20	0	1.50	0	1.50	0	1.25	0

TABLE III - A COMPARISON OF AVERAGE FLAVOR SCORES AT THE VARIOUS BLANCHING TIMES AND EAR SIZES FOR THE 4, 8, AND 12 MONTH EVALUATION PERIODS FOR PACER AND VANGUARD

STORAGE (MONTHS)	CULTIVAR	EAR SIZE	BLANCHING TIMES (MINUTES)								
			6	8	10	12	14	16	18	20	$\bar{X}$
4	Pacer	1	6.25	6.12	6.73	6.81	6.65	7.05	6.54	-	6.59
		2	5.34	5.41	5.83	6.31	6.95	6.45	5.84	6.04	6.00
		3	5.35	5.92	5.43	6.31	5.75	5.55	6.34	5.94	5.80
		$\bar{X}$	5.64	5.82	5.99	6.47	6.45	6.35	6.24	5.99	
	Vanguard	1	7.93	7.63	7.20	6.52	8.13	5.91	7.32	7.52	7.30
		2	7.23	6.83	7.31	6.92	6.73	6.61	6.72	6.52	6.90
		3	6.33	5.83	4.91	7.02	6.73	6.21	5.62	6.62	6.20
		$\bar{X}$	7.16	6.76	6.47	6.82	7.19	6.24	6.55	6.88	
8	Pacer	1	5.18	5.94	5.01	6.01	7.24	6.18	4.71	-	5.78
		2	4.98	5.04	6.11	6.11	6.14	4.38	4.61	6.08	5.43
		3	4.68	5.84	4.61	5.61	6.04	5.38	5.21	5.08	5.31
		$\bar{X}$	4.94	5.61	5.24	5.91	6.47	5.31	4.84	5.58	
	Vanguard	1	6.87	7.96	8.11	8.18	8.18	7.87	6.11	7.26	7.60
		2	6.47	6.66	7.01	7.98	7.38	7.57	6.91	6.96	7.10
		3	5.17	5.36	6.51	6.68	5.88	6.37	6.01	6.67	6.10
		$\bar{X}$	6.17	6.66	7.21	7.61	7.14	7.27	6.34	6.96	
12	Pacer	1	5.21	5.23	5.81	5.85	6.30	6.15	5.80	-	5.77
		2	4.71	4.63	5.61	5.25	6.10	5.85	5.60	5.47	5.46
		3	4.81	5.53	5.81	5.35	5.60	5.15	6.00	5.47	5.46
		$\bar{X}$	4.91	5.13	5.74	5.48	6.00	5.71	5.80	5.47	
	Vanguard	1	7.60	8.10	7.32	7.96	8.32	8.14	7.77	7.26	7.80
		2	6.10	6.70	7.82	6.46	7.32	7.64	7.87	7.56	7.20
		3	5.70	5.50	5.52	5.86	6.62	6.14	6.37	6.46	6.00
		$\bar{X}$	6.46	6.76	6.88	6.76	7.42	7.31	7.33	7.09	

PROGRESS REPORT ON CABBAGE LIPIDS

by

Andrew C. Peng

Lipids are a major constituent of foods. Their presence, quantity, and composition are not only important to organoleptic satisfaction, but also significant to nutrition and keeping quality. A small amount of lipid present in the food makes it more palatable and satisfying, improves and facilitates the utilization of proteins and fat-soluble vitamins, and also provids the essential fatty acids for our body needs.

Three major lipids are found in plant tissue, they are neutral lipids, glycolipids, and phospholipids. Neutral lipids are simple lipids, triglycerides; phospholipids are complex compounds which have a phosphoric acid and a nitrogenous base esterified on the α position of a glyceride; and glycolipids which have one or two galactose molecules linked to a diglyceride unit. These newly identified (3) galactolipids have received more research attention in recent years, they are probably universal constituents of photosynthetic tissue, and believed to play an essential role in photosynthesis of green plants. Sphingolipids are another group, such as sphingomyelin and cerebrosides, these are included in phosolipids and glycolipids, respectively.

Winsconsin Ballhead cabbage (*Brassica oleracea* var. *capitata*, L.) was obtained from The Ohio State University Horticultural farm in Columbus. Two hundred grams of frozen cabbage sample in duplicate were blended with 200 ml of distilled water in a Waring Blendor for 5 minutes. The slurry was mixed thoroughly with 20 grams of silicic acid and 10 grams of Celite in a beaker, transferred quantitatively to a Buchner funnel, and filtered through a Whatman #1 paper at a reduced pressure. The lipids were extracted from the sample pad by the procedureof Bligh and Dyer (2) with Folch reagent (4). Solvent was removed by a rotary evaporator at a reduced pressure, and the dried sample was stored in a vacuum desiccator. A total of 0.20% lipids was obtained. This was agreed with Wheeldon's findings of 0.21% of total lipids (9).

The lipid classes were separated by column chromatogrpphy. The neutral lipids were eluted by chloroform through a silicic acid column while polar lipids were recovered by methanol. The methanol fraction was evaporated and applied onto a Florisil column. Glycolipids were eluted by acetone (8) and methanol was used for removing phospholipids. The sample loading ratio was 20 mg per gram of adsorbent, whereas the elution volume was 25 ml of chloroform and methanol and 50 ml of acetone of adsorbent. The elution was monitored by thin-layer chromatography on silica gel G. The developing solvent for neutral lipids was petroleum ether:diethyl ether:acetic acid (80:20:1 by volume), and chloroform:acetone: methanol:acetic acid:water (65:20:10:10:3 by volume) (6) for polar lipids. Phosphomolybdic acid spray was used for the detection of neutral lipids and phospholipids. The glycolids were identified by the diphenylamine reagent (5), while ninhydrin solution was employed to detect α-amino-containing phospholipids. The separation was also confirmed by the phosphorus determination (1), and the anthrone method for determining galactose (7).

Preliminary results indicated that the neutral lipids were the major component, 55.92%; glydolipids, the next, 37.18%;;and phospholipids, the least, 6.89%. The amount of polar lipids, 44.07%, agreed with the literature, 44.28% (9). The fatty acid composition of each fraction will be determined by gas-liquid chromatography in later phases of this research.

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EFFECT OF SOYBEAN FLOUR ON QUALITY AND PROTEIN CONTENT IN THE MANUFACTURE OF DOUGHNUTS

by

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INTRODUCTION

In recent years there has been an ever increasing interest in protein fortification of foods, both for developing countries, where protein is in short supply and protein malnutrition may be prevalent, and for more highly developed countries, where protein is relatively abundant but may be of low quality.

The protein fortification of baked foods has received particular attention in areas where proteins are abundant. Baked foods fortified with additional amounts of protein present an opportunity to provide an economical mixture of proteins in palatable form, with a full complement of amino acids and consequently an improved biological value of the finished product.

Recently, doughnuts have become an important and profitable item in the operations of most wholesale bakeries and food chains. The doughnut volume has passed the half-billion-dollars-a-year mark and is still growing.

Because of their wide acceptance, high consumption, and low price and because facilities are usually available or can be made readily available for their production and distribution, doughnuts appear to offer special advantages and represent an attractive, economical, and acceptable means for incorporating quality protein into the diet. If this potential is to be effectively realized, however, the physical and organoleptic properties of doughnuts must not be reduced below commercial standards of public acceptance.

Discussion will be limited here to machine-made (chemically leavened) doughnuts because that type represents over 80 % of the doughnut output by the major wholesale and food chain bakeries.

Since soybean is relatively rich in lysime and valine, the first two limiting amino acids of wheat protein, the use of soybean flour as a means of supplementation has received considerable attention in the baking industry. The object of this study was to investigate the use of soybean flour from both the physical and organoleptic characteristics of cake doughnuts.

EXPERIMENTAL PROCEDURE

The soy product used in this investigation was a special-process defatted soy flour designed specifically for baking application and marketed under the trade name "Textrol". It is distinguished from other types of soy flour by its higher protein content (60% protein).

The formula used in proparing the cake doughnuts is presented in Table I.

The dry ingredients were weighed into a 12 quart bowl of a Hobart Mixer Model A-200 FD and blended for 25 minutes on speed 1 and using a flat beater. The lecithin was dissloved in the emulsifier. The shortening and the emulsifier and lecithin mixture were added to the dry ingredients and mixed for 1 minute on speed 1. The liquid vanilla was added to the tap water and the mixture was added to all other ingredients slowly while mixing for 1 minute on speed 1. Then,the mixing was shifted to speed 2 for 2½ minutes. The batter was allowed to rest in the bowl for 15 minutes before it was transferred into the hopper of the do nut continuous making frying machine. The temperature of the water was regulated with respect to the temperature of the mix, of the room, and machine friction so that the final batter temperature would be between 75-78°F. from the mixer.

The doughnut machine used in frying the doughnuts was an automatic electrically heated frying machine Model DR-42 Donut Robot. The do-nut cutter was adjusted to yield the smallest size douthnuts, namely doughnuts weighing 13 ounces per dozen. The fat temperature was regulated between 375-380°F.

The cake flour was replaced by the soy flour at 5% level (based on cake flour weight) and the replacement level was increased by 1% increments until 12%. Then a treatment of 15% replacement was made. The factor 1 x the weight of the soy flour added was used to adjust the water absorption of the soy flour containing mix using the amount of water added to the soy flour non-containg mix as base.

Each batch of doughnut dough made approximately 5½ dozen doughnuts. No samples were collected from the first dozen. Test samples were collected from the second,third, and fourth dozen. The remainder of the run was not sampled.

The volume of four doughnuts was determined by rapeseed displacement on four lots and the volume was divided by the weight to give specific volume. For diameter and height measurement, eight doughnuts were lined up on a yardstick for measurement of total outside diameter and they were stac ed for measurement of total height. The ratio of height to diameter gives an indication of relative plumpness.

The moisture content of the finished doughnut was determined by vacuum oven for five hours.

The fat was extracted from the dried doughnut batter and the finished doughnuts by petroleum ether. The difference between fat content of the finished doughnuts and that of the batter was considered as fat absorption.

The doughnuts were presented to a taste panel for evaluation of flavor, crust color, texture, and appearance (shape and star formation at center hole) after each run and after storage for 2 weeks at 0°F.

RESULTS

1. The specific volume of the doughnuts was increased significantly by inclusion of the soy flour up to 6% replacement level. Additional increase of the soy flour decreased the specific volume significantly.

2. The height/diameter ratio followed the same pattern as the specific volume denoting that doughnuts at 6% replacement level were more well-rounded and more plump. Increasing the increments of the soy flour beyond the 6% replacement level caused the doughnuts to become flatter.

3. The inclusion of the soy flour into the doughnut mix necessitated increasing the water added to the mix by an amount equal to the weight of the soy flour, and the moisture content of the finished doughnuts increased significantly by increasing the increments of the soy flour.

4. The amount of fat absorbed by the doughnuts during frying decreased significantly by incorporation of the soy flour into the mix. The fat absorption was found to be inversely related to the moisture content of the finished doughnuts which had the greatest effect thereon.

5. The flavor and crust color of the doughnuts were not affected by the soy flour, either after each run or after storage for 2 weeks at 0°F. The soy flour doughnuts were compact in texture but not particularly hard or tough. However, they d d not differ significantly from the control when scored after each run. After 2 weeks of storage at 0°F. the soy flour doughnuts scored significantly more tender than the control due to the moisture retention capacity of the soy flour in the crust.

6. The appearance of the doughnuts improved significantly by the addition of soy flour up to 6% replacement level, with six-pointed star at center hole pulled inwardly until almost no hole appeared. Beyond the 6% replacement level, the center star began to lose the six points with an enlarged hole.

7. The replacement of the cake flour by the special-process soy flour in the doughnut mix used in this study resulted in an increase in the protein content of the mix and the finished doughnuts by about 4 and 3% respectively for each 1% replacement.

CONCLUSIONS

On the vasis of these findings we arrive to the conclusion that the cake flour can be replaced by the special-process soy flour up to 6% level without impairement of the volume and appearance of the doughnuts. Doughnuts at 6% replacement level weighed 13.4 oz. per dozen including 1.83 o.. fat absorbed from the frying medium. The protein content in these doughnuts is increased by 20%.

Table I - The Formula

Ingredient	Gm	Based on % Flour Weight
Cake Flour	1000	100
Sugar		
Cane (extra fine granulated)	300	30
Corn (Dextrose)	20	2
Non Fat Dry Milk	60	6
Egg Yolk Solids	70	7
Shortening (hydrogenated veg. oil)	75	7.5
Baking Powder (double acting)	44	4.4
Salt	7	0.7
Vanilla (liquid)	15	1.5
Ground Nutmeg	4	0.4
Lecithin	4	0.4
Emulsifier	11	1.1
Doughnut Mix	1610	
Water	630	

Table II - Effect of Soy Flour Replacement Level on Specific Volume of Cake Doughnuts

Soy Flour Replacement Level %	Weight* gm.	Absolute Volume* cc	Specific Volume cc/gm.
0	124.81	306	2.45
5	125.46	317	2.53
6	126.32	324	2.56
7	125.12	307	2.45
8	124.68	298	2.39
9	124.56	290	2.33
10	124.60	290	2.33
11	123.86	283	2.28
12	123.03	272	2.21
15	120.40	261	2.17

*Average of 4 lots, each of 4 doughnuts

Table III - Effect of Soy Flour Replacement Level on Height/Diameter Ratio of Cake Doughnuts

Soy Flour Replacement Level %	Diameter* inch	1/16	Height* inch	1/16	Height/Diameter Ratio
0	22	5	7	10	0.341
5	22	9	8	3	0.363
6	22	8	8	4	0.366
7	22	9	7	13	0.346
8	22	6	7	11	0.343
9	22	4	7	9	0.340
10	22	4	7	10	0.342
11	22	-	7	11	0.349
12	21	12	7	6	0.339
15	21	8	7	3	0.334

* Average of 3 lots, each of 8 doughnuts

Figure 1. Effect of Soy Flour Replacement Level on Specific Volume in Cake Doughnuts

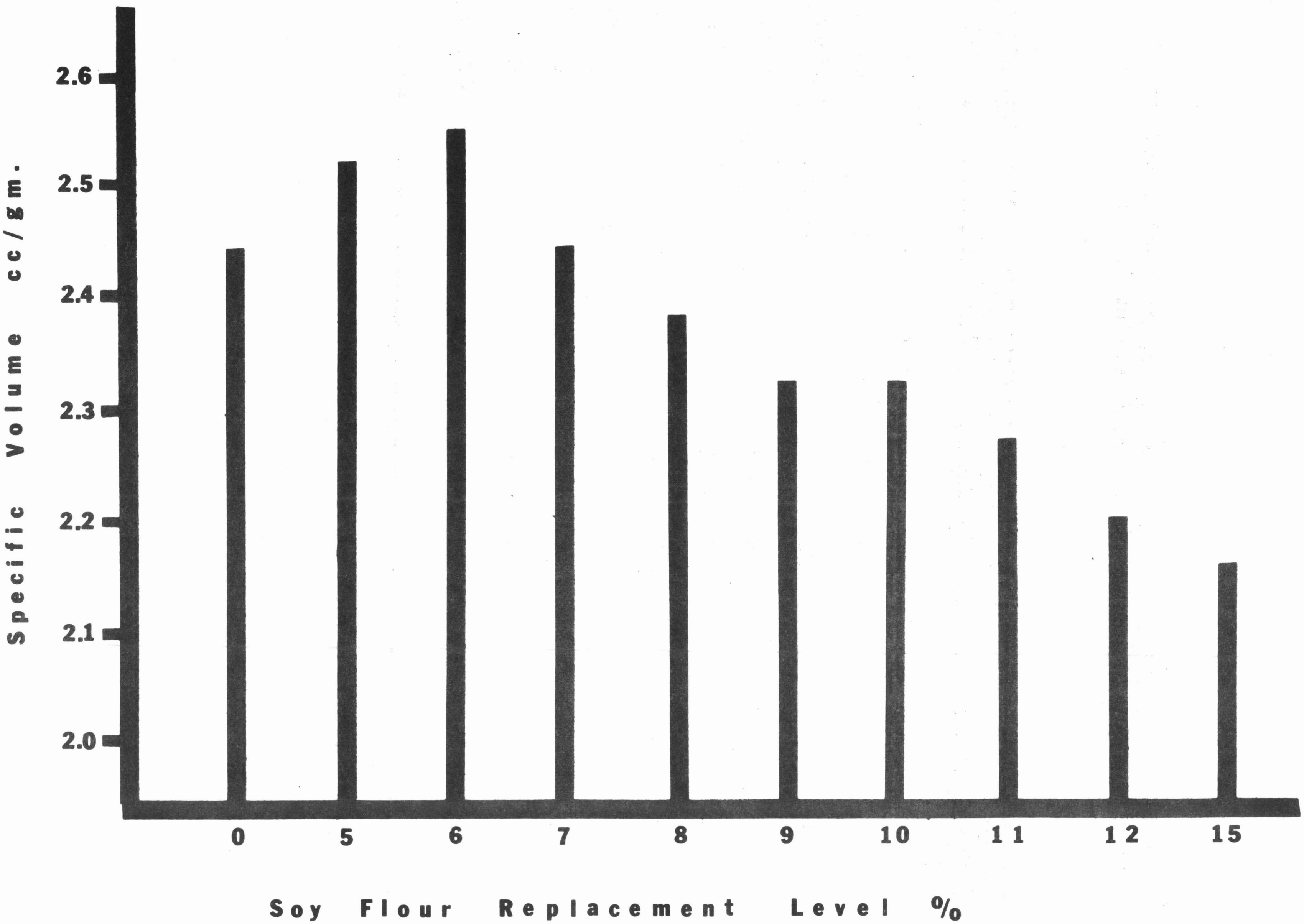


Figure 2. Effect of Soy Flour Replacement Level on Moisture Content in Cake Doughnuts

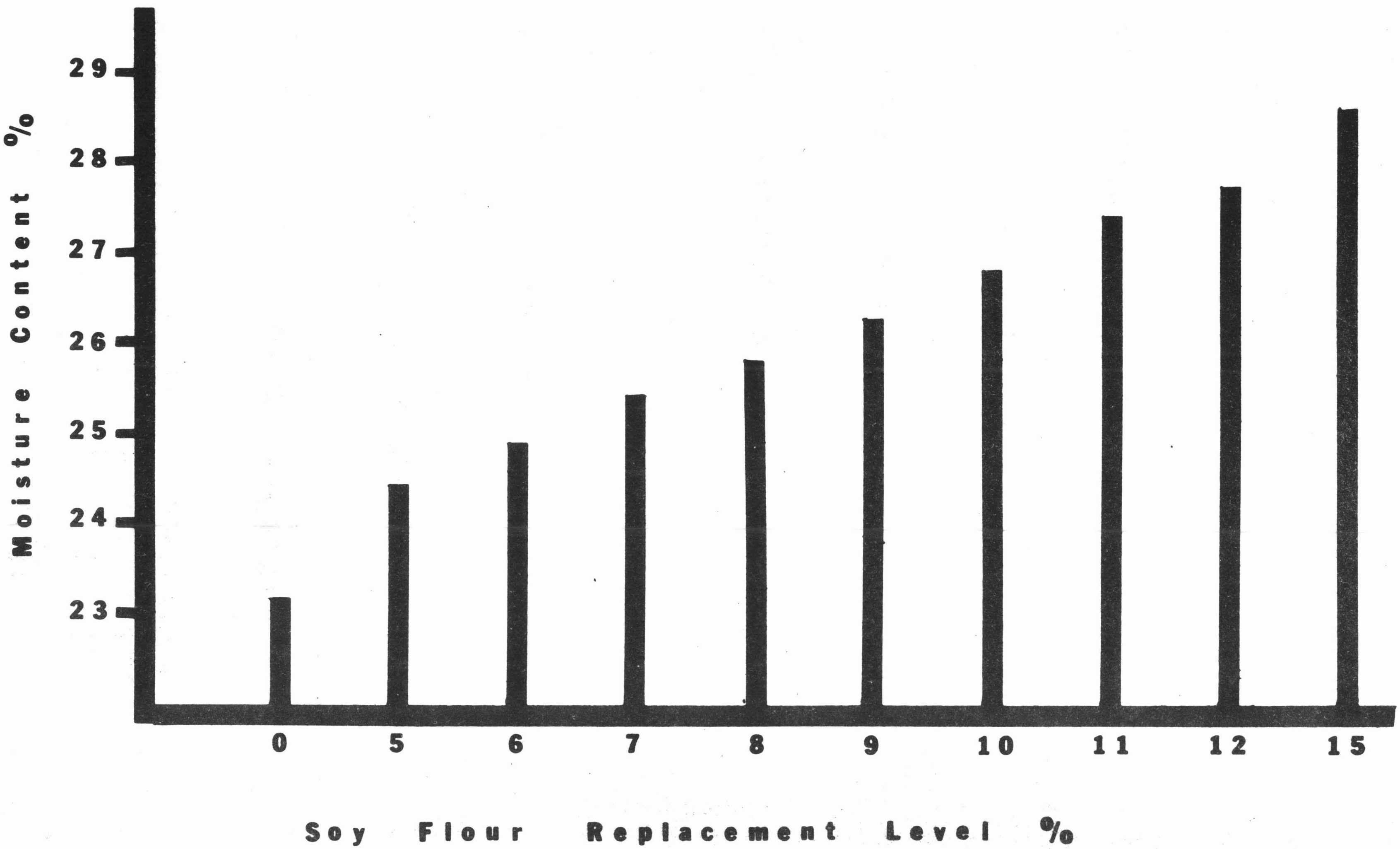
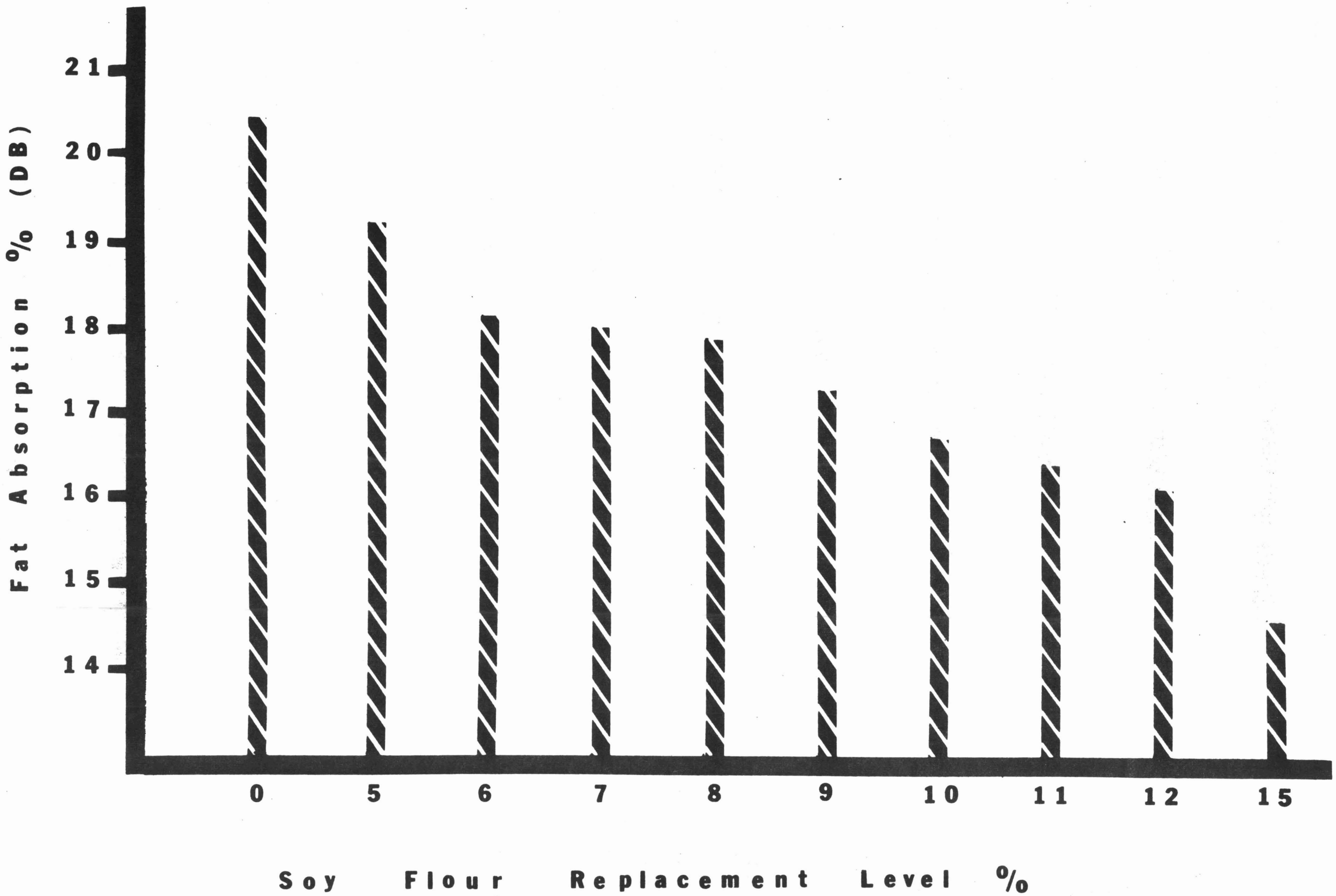


Figure 3. Effect of Soy Flour Replacement Level on Fat Absorption in Cake Doughnuts



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